ANNEX U

IPCC Reference Approach for Estimating CO_2 Emissions from Fossil Fuel Combustion

It is possible to estimate carbon dioxide (CO_2) emissions from fossil fuel consumption using alternative methodologies and different data sources than those described in Annex A. For example, the UNFCCC reporting guidelines request that countries, in addition to their "bottom-up" sectoral methodology, to complete a "top-down" Reference Approach for estimating CO_2 emissions from fossil fuel combustion. Section 1.3 of the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reporting Instructions* states, "If a detailed, Sectoral Approach for energy has been used for the estimation of CO_2 from fuel combustion you are still asked to complete…the Reference Approach…for verification purposes" (IPCC/UNEP/OECD/IEA 1997). This reference method estimates fossil fuel consumption by adjusting national aggregate fuel production data for imports, exports, and stock changes rather than relying on end-user consumption surveys. The basic principle is that once carbon-based fuels are brought into a national economy, they are either saved in some way (e.g., stored in products, kept in fuel stocks, or left unoxidized in ash) or combusted, and therefore the carbon in them is oxidized and released into the atmosphere. Accounting for actual consumption of fuels at the sectoral or sub-national level is not required. The following discussion provides the detailed calculations for estimating CO_2 emissions from fossil fuel combustion from the United States using the IPCC-recommended Reference Approach.

Step 1: Collect and Assemble Data in Proper Format

To ensure the comparability of national inventories, the IPCC has recommended that countries report energy data using the International Energy Agency (IEA) reporting convention. National energy statistics were collected in physical units from several DOE/EIA documents in order to obtain the necessary data on production, imports, exports, and stock changes (EIA 2001a).

It was necessary to make a number of modifications to these data to generate more accurate apparent consumption estimates of these fuels. The first modification adjusts for consumption of fossil fuel feedstocks accounted for in the Industrial Processes chapter, which include unspecified coal for coal coke used in iron and steel production, natural gas used for ammonia production, and petroleum coke used in the production of aluminum, ferroalloys, and titanium dioxide. The second modification adjusts for consumption of bunker fuels, which refer to quantities of fuels used for international transportation estimated separately from U.S. totals. The third modification consists of the addition of U.S. territories data that are typically excluded from the national aggregate energy statistics. The territories include Puerto Rico, U.S. Virgin Islands, Guam, American Samoa, Wake Island, and U.S. Pacific Islands. These data, as well as the production, import, export, and stock change statistics, are presented in Table U-1.

The carbon content of fuel varies with the fuel's heat content. Therefore, for an accurate estimation of CO_2 emissions, fuel statistics were provided on an energy content basis (e.g., BTUs or joules). Because detailed fuel production statistics are typically provided in physical units (as in Table U-1), they were converted to units of energy before CO_2 emissions were calculated. Fuel statistics were converted to their energy equivalents by using conversion factors provided by DOE/EIA. These factors and their data sources are displayed in Table U-2. The resulting fuel type-specific energy data are provided in Table U-3.

Step 2: Estimate Apparent Fuel Consumption

The next step of the IPCC Reference Approach is to estimate "apparent consumption" of fuels within the country. This requires a balance of primary fuels produced, plus imports, minus exports, and adjusting for stock changes. In this way, carbon enters an economy through energy production and imports (and decreases in fuel stocks) and is transferred out of the country through exports (and increases in fuel stocks). Thus, apparent consumption of primary fuels (including crude oil, natural gas liquids, anthracite, bituminous, subbituminous and lignite coal, and natural gas) can be calculated as follows:

Apparent Consumption = Production + Imports - Exports - Stock Change

Flows of secondary fuels (e.g., gasoline, residual fuel, coke) should be added to primary apparent consumption. The production of secondary fuels, however, should be ignored in the calculations of apparent consumption since the carbon contained in these fuels is already accounted for in the supply of primary fuels from which they were derived (e.g., the estimate for apparent consumption of crude oil already contains the carbon from which gasoline would be refined). Flows of secondary fuels should therefore be calculated as follows:

Secondary Consumption = Imports - Exports - Stock Change

Note that this calculation can result in negative numbers for apparent consumption of secondary fuels. This result is perfectly acceptable since it merely indicates a net export or stock increase in the country of that fuel when domestic production is not considered.

Next, the apparent consumption and secondary consumption need to be adjusted for feedstock uses of fuels accounted for in the Industrial Processes chapter, international bunker fuels, and U.S. territory fuel consumption. Bunker fuels and feedstocks accounted for in the Industrial Processes chapter are subtracted from these estimates, while fuel consuption in U.S. territories is added.

The IPCC Reference Approach calls for estimating apparent fuel consumption before converting to a common energy unit. However, certain primary fuels in the United States (e.g., natural gas and steam coal) have separate conversion factors for production, imports, exports, and stock changes. In these cases, it is not appropriate to multiply apparent consumption by a single conversion factor since each of its components have different heat contents. Therefore, United States fuel statistics were converted to their heat equivalents before estimating apparent consumption. Results are provided in Table U-2.

Step 3: Estimate Carbon Emissions

Once apparent consumption is estimated, the remaining calculations are virtually identical to those for the "bottom-up" Sectoral Approach (see Annex A). That is:

- Potential CO_2 emissions were estimated using fuel-specific carbon coefficients (see Table U-3).[1]
- The carbon in products from non-energy uses of fossil fuels (e.g., plastics or asphalt) was then estimated and subtracted (see Table U-4).
- Finally, to obtain actual CO_2 emissions, net emissions were adjusted for any carbon that remained unoxidized as a result of incomplete combustion (e.g., carbon contained in ash or soot).[2]

Step 4: Convert to CO_2 Emissions

Because the IPCC reporting guidelines recommend that countries report greenhouse gas emissions on a full molecular weight basis, the final step in estimating CO_2 emissions from fossil fuel consumption was converting from units of carbon to units of CO_2. Actual carbon emissions were multiplied by the molecular-to-atomic weight ratio of CO_2 to carbon (44/12) to obtain total carbon dioxide emitted from fossil fuel combustion in teragrams (Tg). The results are contained in Table U-5.

Comparison Between Sectoral and Reference Approaches

These two alternative approaches can both produce reliable estimates that are comparable within a few percent. The major difference between methodologies employed by each approach lies in the energy data used to derive carbon emissions (i.e., the actual surveyed consumption for the Sectoral Approach versus apparent

[1] Carbon coefficients from EIA were used wherever possible. Because EIA did not provide coefficients for coal, the IPCC-recommended emission factors were used in the top-down calculations for these fuels. See notes in Table U-4 for more specific source information.

[2] For the portion of carbon that is unoxidized during coal combustion, the IPCC suggests a global average value of 2 percent. However, because combustion technologies in the United States are more efficient, the United States inventory uses 1 percent in its calculations for petroleum and coal and 0.5 percent for natural gas.

consumption derived for the Reference Approach). In theory, both approaches should yield identical results. In practice, however, slight discrepancies occur. For the United States, these differences are discussed below.

Differences in Total Amount of Energy Consumed

Table U-7[3] summarizes the differences between the Reference and Sectoral approaches in estimating total energy consumption in the United States. Although theoretically the two methods should arrive at the same estimate for U.S. energy consumption, the Reference Approach provides an energy total that is 2.9 percent lower than the Sectoral Approach for 2000. The greatest difference lies in the higher estimate of petroleum consumption with the Sectoral Approach (3.5 percent).

There are several potential sources for the discrepancies in consumption estimates:

- *Product Definitions.* The fuel categories in the Reference Approach are different from those used in the Sectoral Approach, particularly for petroleum. For example, the Reference Approach estimates apparent consumption for crude oil. Crude oil is not typically consumed directly, but refined into other products. As a result, the United States does not focus on estimating the energy content of the various grades of crude oil, but rather estimating the energy content of the various products resulting from crude oil refining. The United States does not believe that estimating apparent consumption for crude oil, and the resulting energy content of the crude oil, is the most reliable method for the United States to estimate its energy consumption. Other differences in product definitions include using sector-specific coal statistics in the Sectoral Approach (i.e., residential, commercial, industrial coking, industrial other, and transportation coal), while the Reference Approach characterizes coal by rank (i.e. anthracite, bituminous, etc.). Also, the liquefied petroleum gas (LPG) statistics used in the bottom-up calculations are actually a composite category composed of natural gas liquids (NGL) and LPG.
- *Heat Equivalents.* It can be difficult to obtain heat equivalents for certain fuel types, particularly for categories such as "crude oil" where the key statistics are derived from thousands of producers in the United States and abroad. For heat equivalents by coal rank, it was necessary to refer back to EIA's *State Energy Data Report 1992* (1994) because this information is no longer published.
- *Possible inconsistencies in U.S. Energy Data.* The United States has not focused its energy data collection efforts on obtaining the type of aggregated information used in the Reference Approach. Rather, the United States believes that its emphasis on collection of detailed energy consumption data is a more accurate methodology for the United States to obtain reliable energy data. Therefore, top-down statistics used in the Reference Approach may not be as accurately collected as bottom-up statistics applied to the Sectoral Approach.
- *Balancing Item.* The Reference Approach uses *apparent* consumption estimates while the Sectoral Approach uses *reported* consumption estimates. While these numbers should be equal, there always seems to be a slight difference that is often accounted for in energy statistics as a "balancing item."

Differences in Estimated CO_2 Emissions

Given these differences in energy consumption data, the next step for each methodology involved estimating emissions of CO_2. Table U-8 summarizes the differences between the two methods in estimated carbon emissions.

As mentioned above, for 2000, the Reference Approach resulted in a 2.9 percent lower estimate of energy consumption in the United States than the Sectoral Approach. However, the resulting emissions estimate for the Reference Approach was 0.6 percent lower. Both methods' estimates of natural gas emissions are almost exactly the same, but coal emission estimates from the Reference Approach are lower than the Sectoral Approach, while higher for petroleum. Potential reasons for these differences may include:

- *Product Definitions.* Coal data is aggregated differently in each methodology, as noted above. The format used for the Sectoral Approach likely results in more accurate estimates than in the Reference Approach. Also, the Reference Approach relies on a "crude oil" category for determining petroleum-related emissions.

[3] Although complete energy consumption data and calculations are not presented, comparison tables are also presented for 1996.

Given the many sources of crude oil in the United States, it is not an easy matter to track potential differences in carbon content between many different sources of crude, particularly since information on the carbon content of crude oil is not regularly collected.

- *Carbon Coefficients.* The Reference Approach relies on several default carbon coefficients by rank provided by IPCC (IPCC/UNEP/OECD/IEA 1997), while the Sectoral Approach uses annually updated category-specific coefficients by sector that are likely to be more accurate. Also, as noted above, the carbon coefficient for crude oil is more uncertain than that for specific secondary petroleum products, given the many sources and grades of crude oil consumed in the United States.

Although the two approaches produce similar results, the United States believes that the "bottom-up" Sectoral Approach provides a more accurate assessment of CO_2 emissions at the fuel level. This improvement in accuracy is largely a result of the data collection techniques used in the United States, where there has been more emphasis on obtaining the detailed products-based information used in the Sectoral Approach than obtaining the aggregated energy flow data used in the Reference Approach. The United States believes that it is valuable to understand both methods.

References

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Table U-1: 2000 U.S. Energy Statistics (Physical Units)

Fuel Category (Units)	Fuel Type	Production	Imports	Exports	Stock Change	Adjustment	Bunkers	U.S. Territories
Solid Fuels (Thousand Short Tons)	Anthracite Coal	4,508	a	a	a			
	Bituminous Coal	548,467	a	a	a			
	Sub-bituminous Coal	433,784	a	a	a			
	Lignite	88,740	a	a	a			
	Coke		3,781	1,146	227			
	Unspecified Coal		12,513	58,489	(40,245)	27,325		441
Gas Fuels (Million Cubic Feet)	Natural Gas	18,377,829	3,726,290	237,035	(845,082)	330,653		11,400
Liquid Fuels (Thousand Barrels)	Crude Oil	2,130,707	3,319,816	18,352	(25,538)			
	Nat Gas Liquids and LRGs	699,415	93,755	28,470	(6,999)			2,203
	Other Liquids	52,196	211,023	17,935	2,699			
	Motor Gasoline	85,938	156,230	52,539	(1,089)			35,408
	Aviation Gasoline		336	0	(309)			
	Kerosene		822	779	(764)			1,150
	Jet Fuel		59,125	11,628	4,017		143,769	
	Distillate Fuel		107,919	63,198	(7,436)		19,704	21,590
	Residual Fuel		128,912	50,858	370		70,634	16,071
	Naptha for petrochemical feedstocks		43,357	0	488			
	Petroleum Coke		394	116,589	1,360	13,966		
	Other Oil for petrochemical feedstocks		52,338	0	125			
	Special Napthas		3,873	7,425	(239)			
	Lubricants		4,950	9,472	279			223
	Waxes		860	1,293	70			
	Asphalt/Road Oil		10,300	2,104	8,183			
	Still Gas		0	0	0			
	Misc. Products		76	67	(601)			38,359

[a] Included in Unspecified Coal

Data Sources: Solid and Gas Fuels – EIA (2001a) Annual Energy Review 2000; Liquid Fuels - Petroleum Supply Annual 2000, Table 2.

Table U-2: Conversion Factors to Energy Units (Heat Equivalents)

Fuel Category (Units)	Fuel Type	Production	Imports	Exports	Stock Change	Adjustment	Bunkers	U.S. Territories
Solid Fuels (Million Btu/Short Ton)	Anthracite Coal	22.57						
	Bituminous Coal	23.89						
	Sub-bituminous Coal	17.14						
	Lignite	12.87						
	Coke		24.80	24.80	24.80			
	Unspecified		25.00	26.24	21.07	27.43		25.14
Natural Gas (BTU/Cubic Foot)		1,027	1,022	1,006	1,027	1,027		
Liquid Fuels (Million Btu/Barrel)	Crude Oil	5.80	5.96	5.80	5.80		5.80	5.80
	Nat Gas Liquids and LRGs	3.73	3.73	3.73	3.73		3.73	3.73
	Other Liquids	5.83	5.83	5.83	5.83		5.83	5.83
	Motor Gasoline	5.21	5.21	5.21	5.21		5.21	5.21
	Aviation Gasoline		5.05	5.05	5.05		5.05	5.05
	Kerosene		5.67	5.67	5.67		5.67	5.67
	Jet Fuel		5.67	5.67	5.67		5.67	5.67
	Distillate Fuel		5.83	5.83	5.83		5.83	5.83
	Residual Oil		6.29	6.29	6.29		6.29	6.29
	Naptha for petrochemical feedstocks		5.25	5.25	5.25		5.25	5.25
	Petroleum Coke		6.02	6.02	6.02	6.02	6.02	6.02
	Other Oil for petrochemical feedstocks		5.83	5.83	5.83		5.83	5.83
	Special Napthas		5.25	5.25	5.25		5.25	5.25
	Lubricants		6.07	6.07	6.07		6.07	6.07
	Waxes		5.54	5.54	5.54		5.54	5.54
	Asphalt/Road Oil		6.64	6.64	6.64		6.64	6.64
	Still Gas		6.00	6.00	6.00		6.00	6.00
	Misc. Products		5.80	5.80	5.80		5.80	5.80

Data Sources: Coal and lignite production – EIA (1994) State Energy Data Report 1992; Unspecified Solid Fuels - EIA (2001b) Monthly Energy Review, Nov 2000;
Coke, Natural Gas and Petroleum Products – EIA (2001b) Annual Energy Review 2000.

Table U-3: 2000 Apparent Consumption of Fossil Fuels (TBtu)

Fuel Category	Fuel Type	Production	Imports	Exports	Stock Change	Adjustment	Bunkers	U.S. Territories	Apparent Consumption
Solid Fuels	Anthracite Coal	101.8							**101.8**
	Bituminous Coal	13,102.9							**13,102.9**
	Sub-bituminous Coal	7,435.1							**7,435.1**
	Lignite	1,141.7							**1,141.7**
	Coke		93.8	28.4	5.6				**59.7**
	Unspecified		312.8	1,534.9	(848.0)	749.4		11.1	**(1,112.4)**
Gas Fuels	Natural Gas	18,874.0	3,808.3	238.5	(867.9)	339.6			**22,972.2**
Liquid Fuels	Crude Oil	12,358.1	19,779.5	106.4	(148.1)				**32,179.2**
	Nat Gas Liquids and LRGs	2,610.9	350.0	106.3	(26.1)			8.2	**2,889.0**
	Other Liquids	304.0	1,229.2	104.5	15.7				**1,413.1**
	Motor Gasoline	447.7	814.0	273.7	(5.7)			184.5	**1,178.1**
	Aviation Gasoline		1.7	0.0	(1.6)				**3.3**
	Kerosene		4.7	4.4	(4.3)			6.5	**11.1**
	Jet Fuel		335.2	65.9	22.8		815.2		**(568.6)**
	Distillate Fuel		628.6	368.1	(43.3)		114.8	125.8	**314.8**
	Residual Oil		810.5	319.7	2.3		444.1	101.0	**145.4**
	Naptha for petrochemical feedstocks		227.5	0.0	2.6				**225.0**
	Petroleum Coke		2.4	702.3	8.2	84.1			**(792.3)**
	Other Oil for petrochemical feedstocks		304.9	0.0	0.7				**304.1**
	Special Napthas		20.3	39.0	(1.3)				**(17.4)**
	Lubricants		30.0	57.4	1.7			1.4	**(27.8)**
	Waxes		4.8	7.2	0.4				**(2.8)**
	Asphalt/Road Oil		68.4	14.0	54.3				**0.1**
	Still Gas		0.0	0.0	0.0				**0.0**
	Misc. Products		0.4	0.4	(3.5)			222.3	**225.9**
Total		**56,376.3**	**28,826.8**	**3,971.2**	**(1,835.5)**	**1,173.1**	**1,374.0**	**660.8**	**81,181.0**

Note: Totals may not sum due to independent rounding.

Table U-4: 2000 Potential Carbon Dioxide Emissions

Fuel Category	Fuel Type	Apparent Consumption (QBtu)	Carbon Coefficients (Tg Carbon/QBtu)	Potential Emissions (Tg CO_2 Eq.)
Solid Fuels	Anthracite Coal	0.102	26.86	**10.0**
	Bituminous Coal	13.103	25.86	**1,242.4**
	Sub-bituminous Coal	7.435	26.26	**715.9**
	Lignite	1.142	27.66	**115.8**
	Coke	0.060	25.56	**5.6**
	Unspecified	(1.112)	25.34	**(103.3)**
Gas Fuels	Natural Gas	22.972	14.47	**1,218.8**
Liquid Fuels	Crude Oil	32.179	20.23	**2,387.2**
	Nat Gas Liquids and LRGs	2.889	16.99	**180.0**
	Other Liquids	1.413	20.23	**104.8**
	Motor Gasoline	1.178	19.34	**83.5**
	Aviation Gasoline	0.003	18.87	**0.2**
	Kerosene	0.011	19.72	**0.8**
	Jet Fuel	(0.569)	19.33	**(40.3)**
	Distillate Fuel	0.315	19.95	**23.0**
	Residual Oil	0.145	21.49	**11.5**
	Naptha for petrochemical feedstocks	0.225	18.14	**15.0**
	Petroleum Coke	(0.792)	27.85	**(80.9)**
	Other Oil for petrochemical feedstocks	0.304	19.95	**22.2**
	Special Napthas	(0.017)	19.86	**(1.3)**
	Lubricants	(0.028)	20.24	**(2.1)**
	Waxes	(0.003)	19.81	**(0.2)**
	Asphalt/Road Oil	0.000	20.62	**0.0**
	Still Gas	0.000	17.51	**0.0**
	Misc. Products	0.226	20.23	**16.8**
Total				**5,925.5**

Data Sources: Coal and Lignite – IPCC (1997) Revised 1996 IPCC Guidelines Reference Manual, Table 1-1; Unspecified Solid Fuels - EIA (2001b) Monthly Energy Review, November 2001 Table C1 (U.S. Average); Natural Gas and Liquid Fuels - EIA (2000) *Emissions of Greenhouse Gases in the United States 1999.*
Note: Totals may not sum due to independent rounding.

Table U-5: 2000 Non-Energy Carbon Stored in Products

Fuel Type	Consumption for Non-Energy Use (TBtu)	Carbon Coefficients (Tg Carbon/QBtu)	Carbon Content (Tg Carbon)	Fraction Sequestered	Carbon Stored (Tg CO_2 Eq.)
Coal	26.4	25.56	0.7	0.75	**1.9**
Natural Gas	342.4	14.47	5.0	0.63	**11.5**
Asphalt & Road Oil	1,275.7	20.62	26.3	1.00	**96.5**
LPG	1,707.3	16.88	28.8	0.63	**66.8**
Lubricants	370.6	20.24	7.5	0.09	**2.5**
Pentanes Plus	286.8	18.24	5.2	0.63	**12.1**
Petrochemical Feedstocks	a	a	a	a	**54.9**
Petroleum Coke	141.4	27.85	3.9	0.50	**7.2**
Special Naptha	97.4	19.86	1.9	0.00	**0.0**
Waxes/Misc.	a	a	a	a	**13.5**
Misc. U.S. Territories Petroleum	a	a	a	a	**16.5**
Total					**283.4**

[a] Values for Misc. U.S. Territories Petroleum, Petrochemical Feedstocks and Waxes/Misc. are not shown because these categories are aggregates of numerous smaller components.
Note: Totals may not sum due to independent rounding.

Table U-6: 2000 Reference Approach CO_2 Emissions from Fossil Fuel Consumption (Tg CO_2 Eq. unless otherwise noted)

Fuel Category	Potential Emissions	Carbon Sequestered	Net Emissions	Fraction Oxidized	Total Emissions
Coal	1,986.4	1.9	1,984.5	99.0%	**1,964.7**
Petroleum	2,720.3	270.0	2,450.3	99.0%	**2,425.8**
Natural Gas	1,218.8	11.5	1,207.3	99.5%	**1,201.3**
Total	**5,925.5**	**283.4**	**5,642.2**	-	**5,591.8**

Note: Totals may not sum due to independent rounding.

Table U-7: Energy Consumption in the United States by Estimating Approach (TBtu)*

Approach	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sectoral	**70,996.2**	**70,588.5**	**71,959.5**	**73,512.7**	**75,089.7**	**76,034.7**	**78,557.0**	**79,713.8**	**79,744.1**	**81,242.7**	**83,606.3**
Coal	18,175.6	18,072.9	18,278.9	18,929.1	19,113.6	19,205.8	20,126.9	20,670.7	20,872.0	20,949.9	21,732.3
Natural Gas	18,912.2	19,233.6	19,755.5	20,437.1	20,921.5	21,813.1	22,212.5	22,307.8	21,532.4	21,907.9	23,038.0
Petroleum	33,908.4	33,282.0	33,925.2	34,146.6	35,054.6	35,015.8	36,217.6	36,735.2	37,339.8	38,384.9	38,836.0
Reference (Apparent)	**69,497.8**	**67,934.4**	**69,395.8**	**71,364.6**	**72,997.9**	**73,815.8**	**76,242.4**	**77,589.9**	**77,561.4**	**79,015.7**	**80,181.0**
Coal	18,408.1	17,498.9	17,817.6	18,339.5	18,791.5	18,601.1	19,567.8	20,230.2	20,104.1	20,188.7	20,728.7
Natural Gas	19,264.8	19,244.0	19,752.1	20,466.7	20,910.5	21,794.5	22,179.3	22,155.9	21,520.0	21,918.3	22,972.2
Petroleum	31,824.9	31,191.5	31,826.1	33,558.5	33,295.9	33,420.2	34,495.3	35,203.9	35,937.3	36,908.7	37,480.1
Difference	**-2.1%**	**-3.8%**	**-3.6%**	**-2.9%**	**-2.8%**	**-2.9%**	**-2.9%**	**-2.7%**	**-2.7%**	**-2.7%**	**-2.9%**
Coal	1.3%	-3.2%	-2.5%	-3.1%	-1.7%	-3.1%	-2.8%	-2.1%	-3.7%	-3.6%	-4.6%
Natural Gas	1.9%	-0.1%	+	0.1%	-0.1%	-0.1%	-0.1%	-0.7%	-0.1%	+	-0.3%
Petroleum	-6.1%	-6.3%	-6.2%	-4.7%	-5.0%	-4.6%	-4.8%	-4.2%	-3.8%	-3.8%	-3.5%

* Includes U.S. territories

+ Does not exceed 0.05%

Note: Totals may not sum due to independent rounding.

Table U-8: CO_2 Emissions from Fossil Fuel Combustion by Estimating Approach (Tg CO_2 Eq.)

Approach	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sectoral	**4,779.6**	**4,732.8**	**4,835.8**	**4,950.7**	**5,047.0**	**5,084.8**	**5,266.3**	**5,339.2**	**5,355.8**	**5,448.4**	**5,623.1**
Coal	1,692.6	1,684.0	1,702.2	1,764.1	1,782.6	1,792.7	1,878.4	1,930.5	1,949.7	1,956.9	2,030.1
Natural Gas	988.8	1,006.1	1,035.0	1,070.3	1,093.6	1,141.3	1,162.4	1,166.7	1,125.8	1,145.2	1,204.8
Petroleum	2,098.2	2,042.6	2,098.6	2,116.3	2,170.8	2,150.9	2,25.6	2,242.0	2,280.3	2,346.3	2,388.2
Reference (Apparent)	**4,832.3**	**4,693.2**	**4,800.5**	**4,931.7**	**5,035.8**	**5,067.2**	**5,249.7**	**5,349.3**	**5,357.7**	**5,437.1**	**5,591.8**
Coal	1,746.9	1,657.8	1,686.0	1,735.1	1,778.8	1,761.3	1,852.3	1,914.5	1,905.6	1,915.9	1,964.7
Natural Gas	1,007.4	1,006.7	1,034.8	1,071.8	1,093.0	1,140.3	1,160.6	1,158.7	1,125.2	1,145.8	1,201.3
Petroleum	2,078.0	2,028.7	2,079.6	2,124.8	2,163.9	2,165.6	2,236.8	2,276.1	2,326.9	2,375.4	2,425.8
Difference	**1.1%**	**-0.8%**	**-0.7%**	**-0.4%**	**-0.2%**	**-0.3%**	**-0.3%**	**0.2%**	**+**	**-0.2%**	**-0.6%**
Coal	3.2%	-1.6%	-0.9%	-1.6%	-0.2%	-1.7%	-1.4%	-0.8%	-2.3%	-2.1%	-3.2%
Natural Gas	1.9%	0.1%	-0.0%	-0.1%	-0.1%	-0.1%	-0.2%	-0.7%	-0.1%	+	-0.3%
Petroleum	-1.0%	-0.7%	-0.9%	-0.4%	-0.3%	0.7%	0.5%	1.5%	2.0%	1.2%	1.6%

+ Does not exceed 0.05%

Note: Totals may not sum due to independent rounding. Includes U.S. territories.